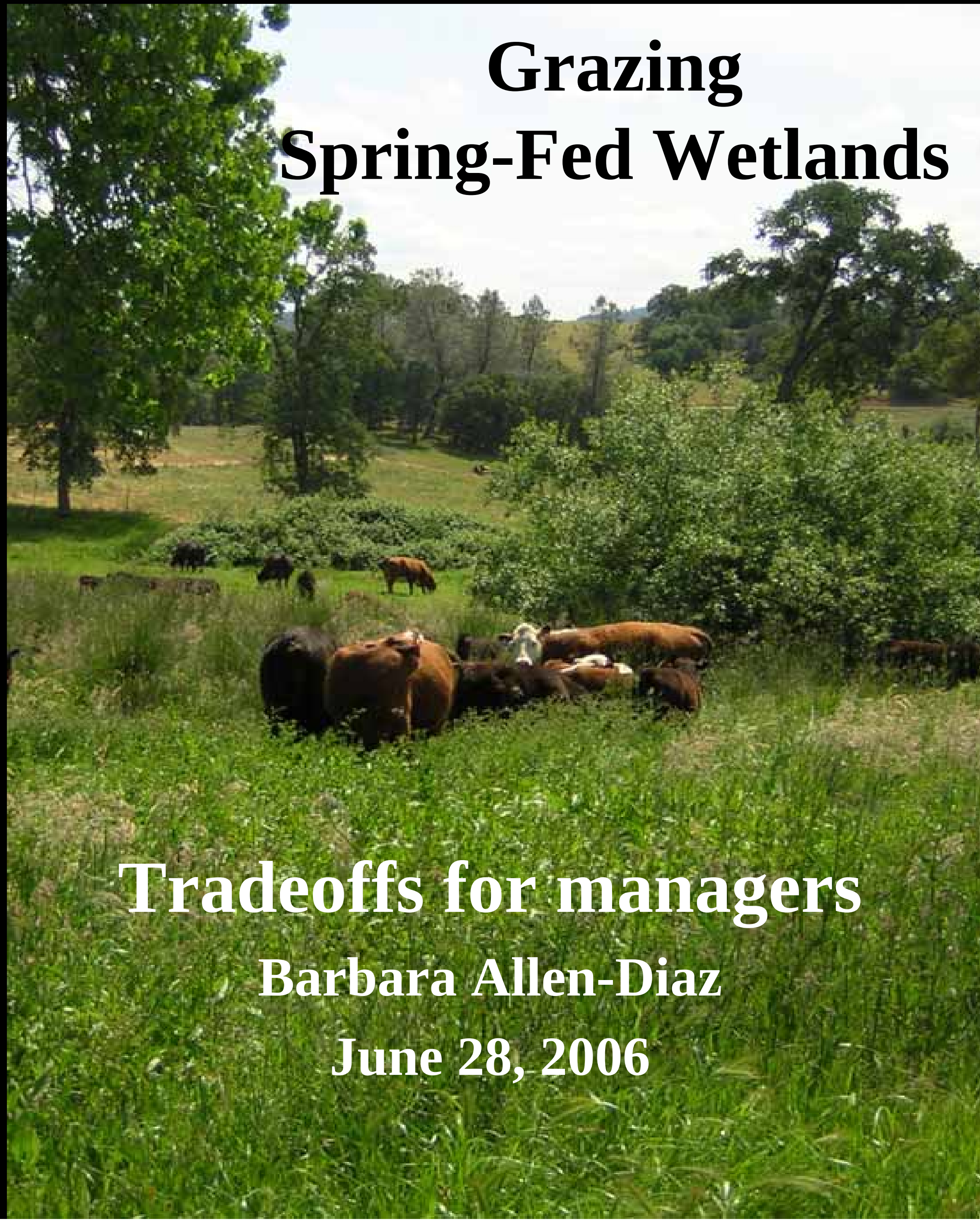
# Grazing Spring-Fed Wetlands



## Tradeoffs for managers

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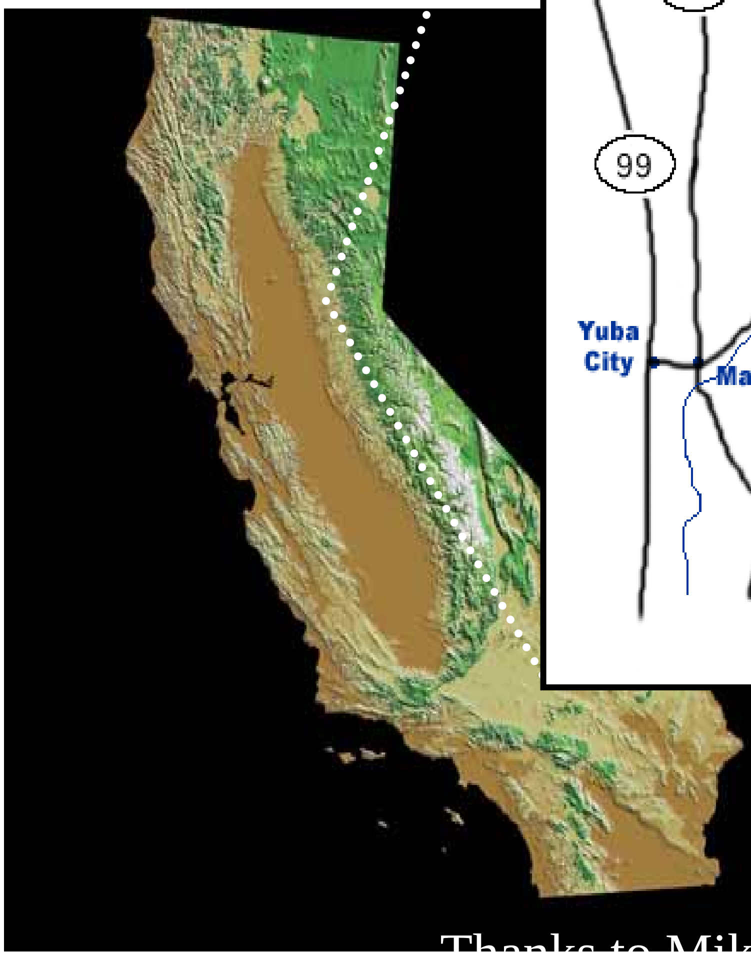
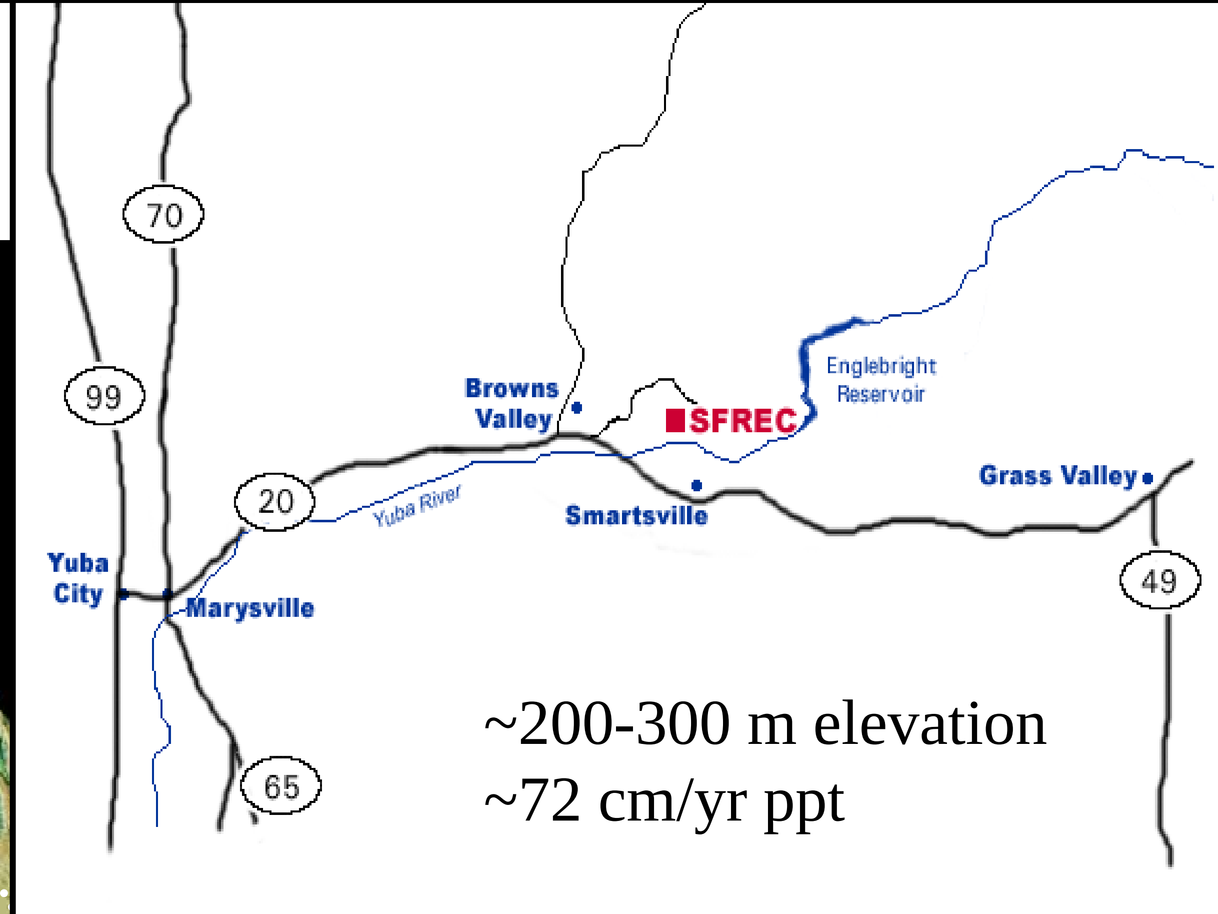
**June 28, 2006**

# Research Questions

- What are the effects of grazing on spring-fed wetlands?
- What variables are most important to determine ecosystem effects?
- Does perception of grazing match measured effects of grazing?
- How can research information about about grazing inform management strategies?

# UC Sierra Foothill Research & Extension Center



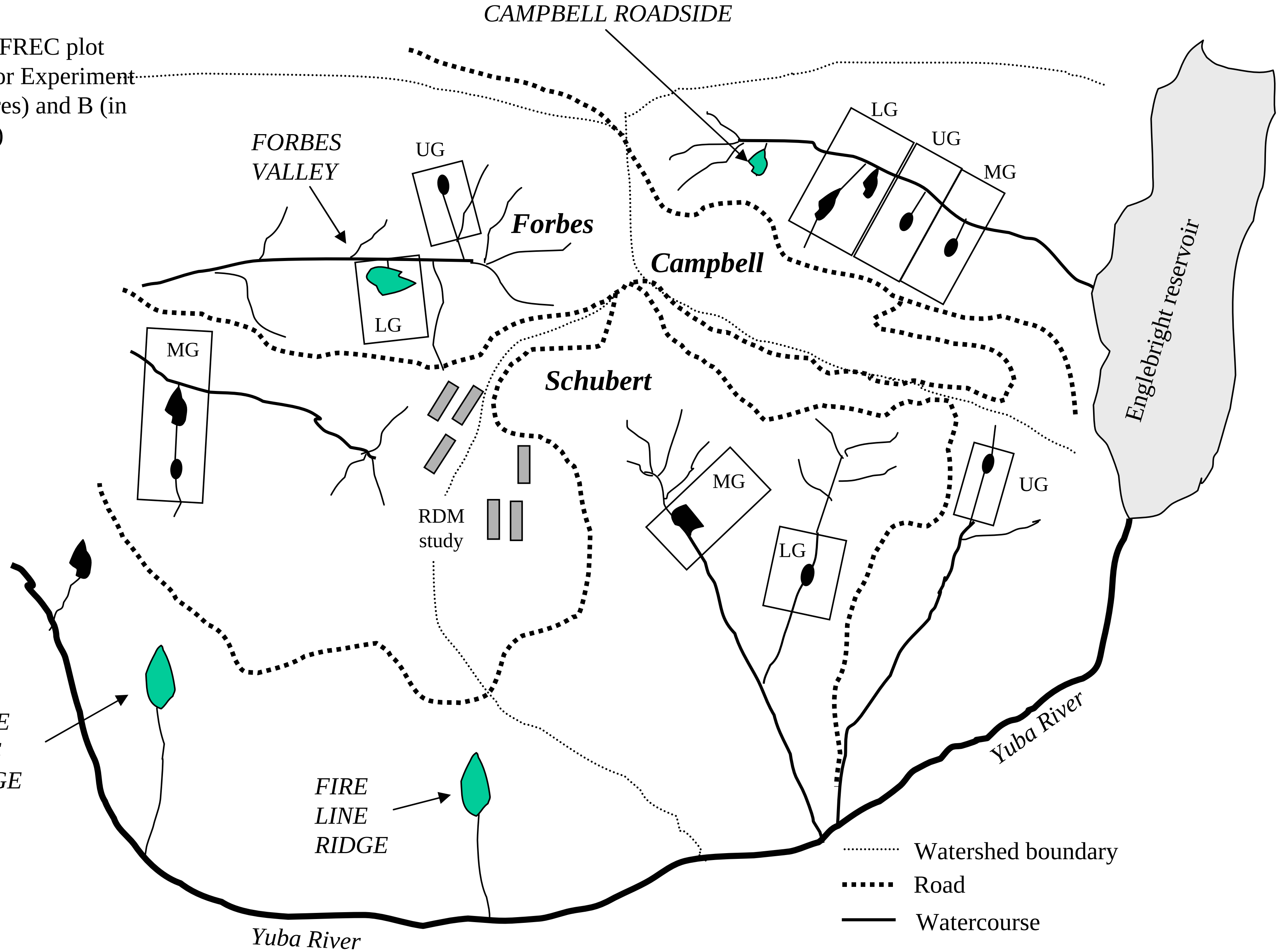



~200-300 m elevation
~72 cm/yr ppt

# At SFREC we examined

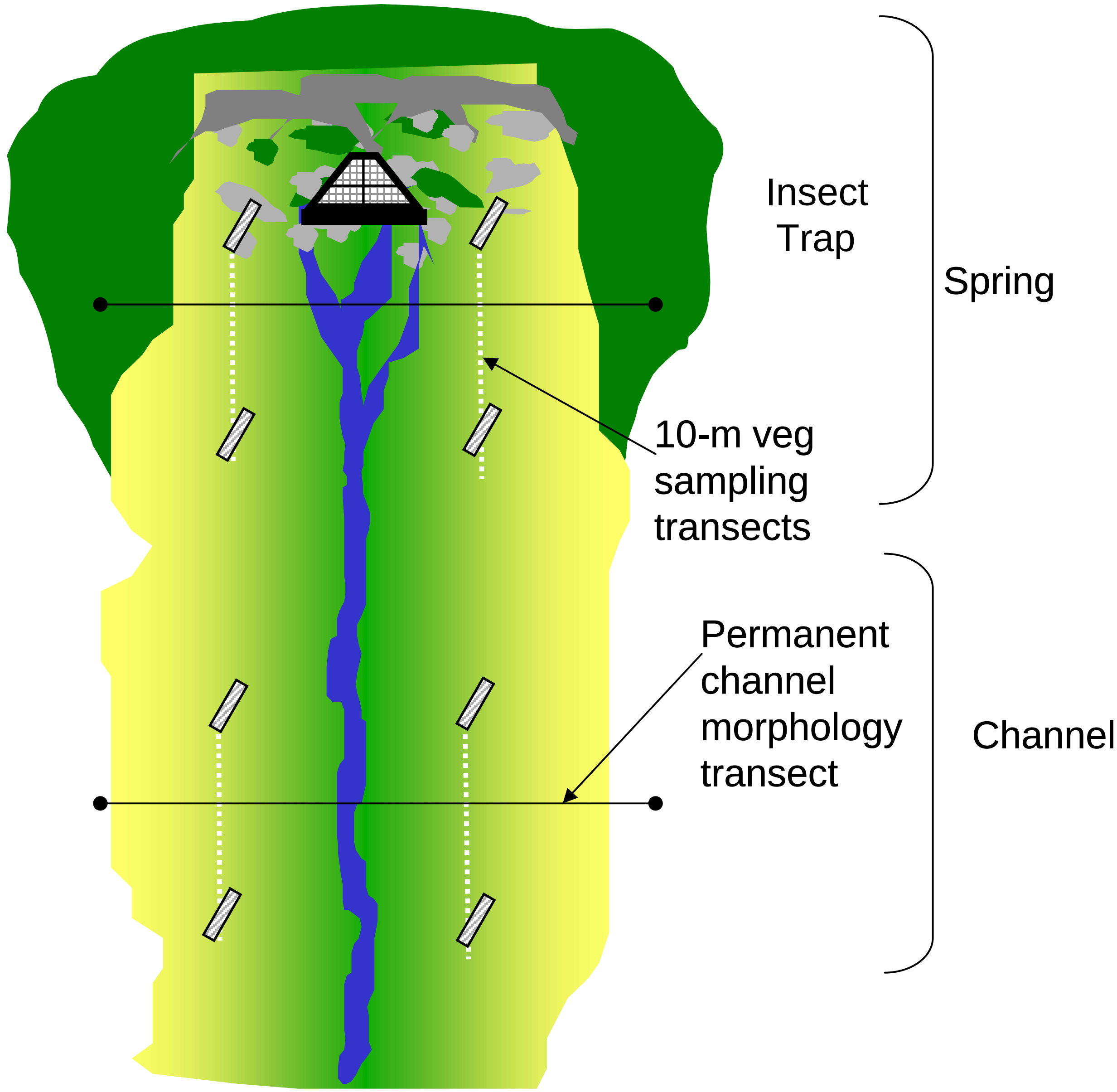
- Species composition
- Vegetation cover
- Water quality
- Channel morphology
- Emergent aquatic insect abundance
- Nutrient cycling

Figure 1. SFREC plot locations for Experiment A (in squares) and B (in blue-green)

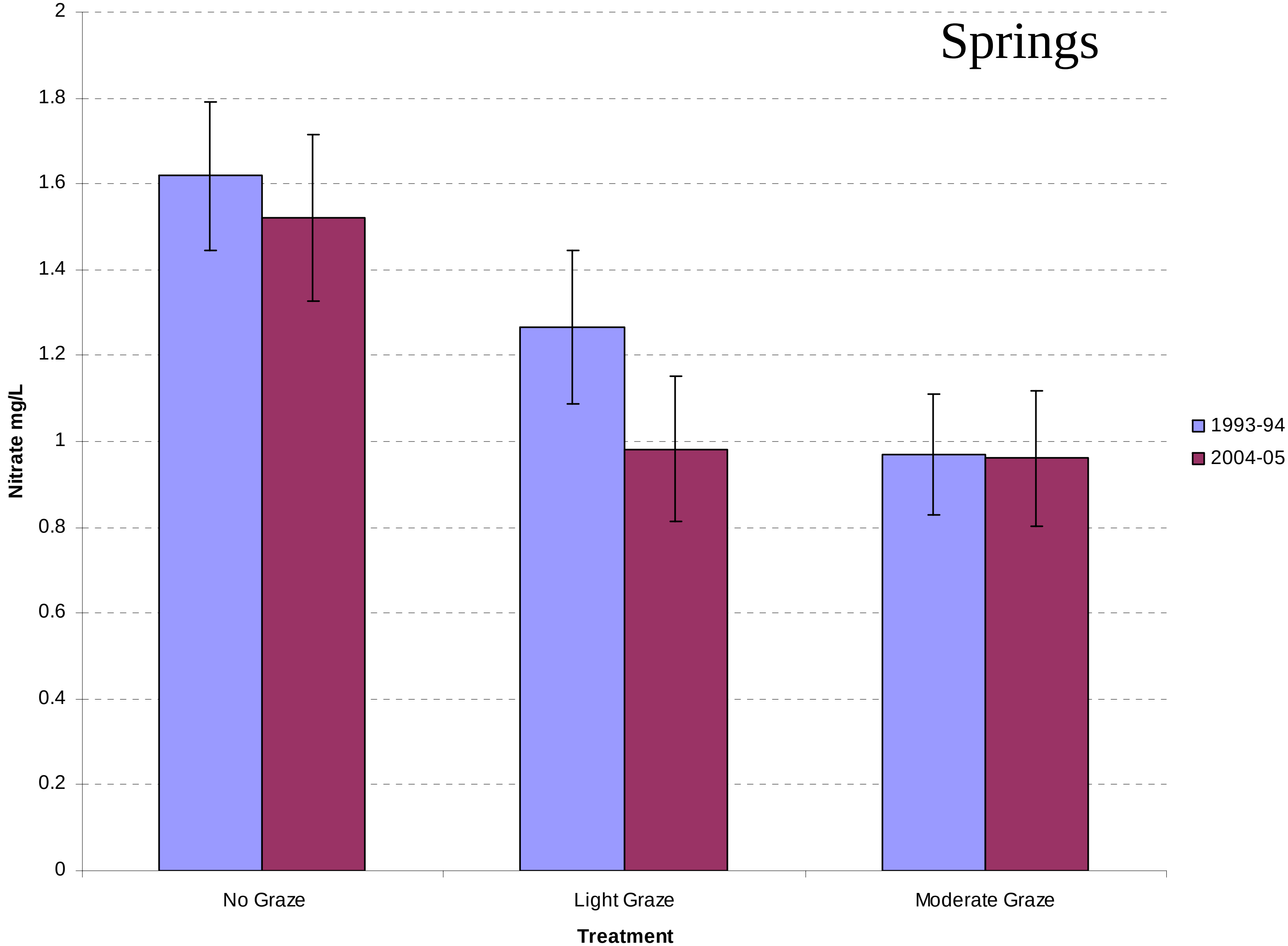


# Grazing design

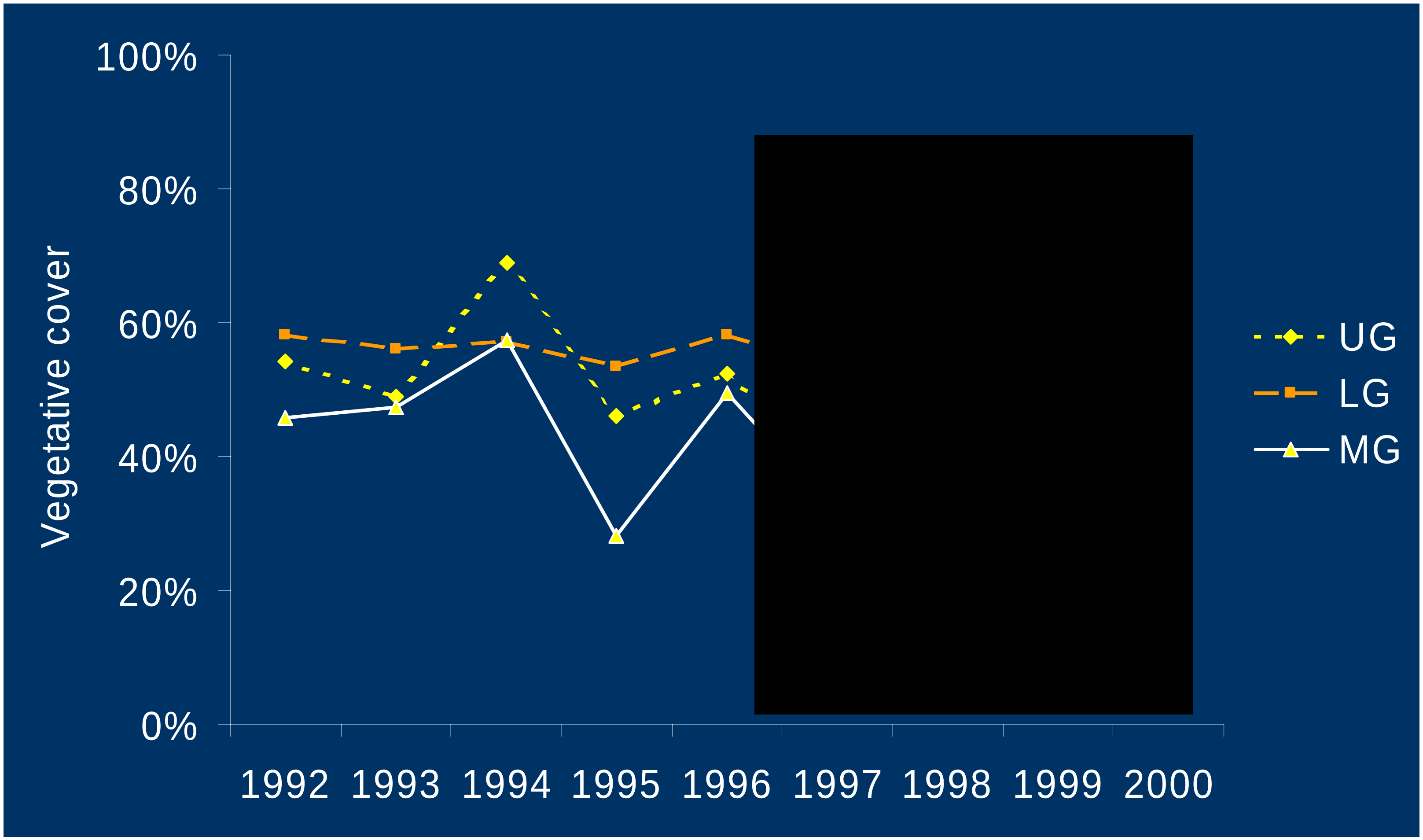
- Base treatments on upland RDM
  - Ungrazed, LG ~1200-1500 kg/ha,
  - MG~600-900 kg/ha
  - Make pastures big enough (2-5 ha)
- Simulate season-long grazing
  - Bring animals on in Nov/Dec, Feb/March
  - Clean-up to achieve RDM in May
- Closely monitor RDM levels

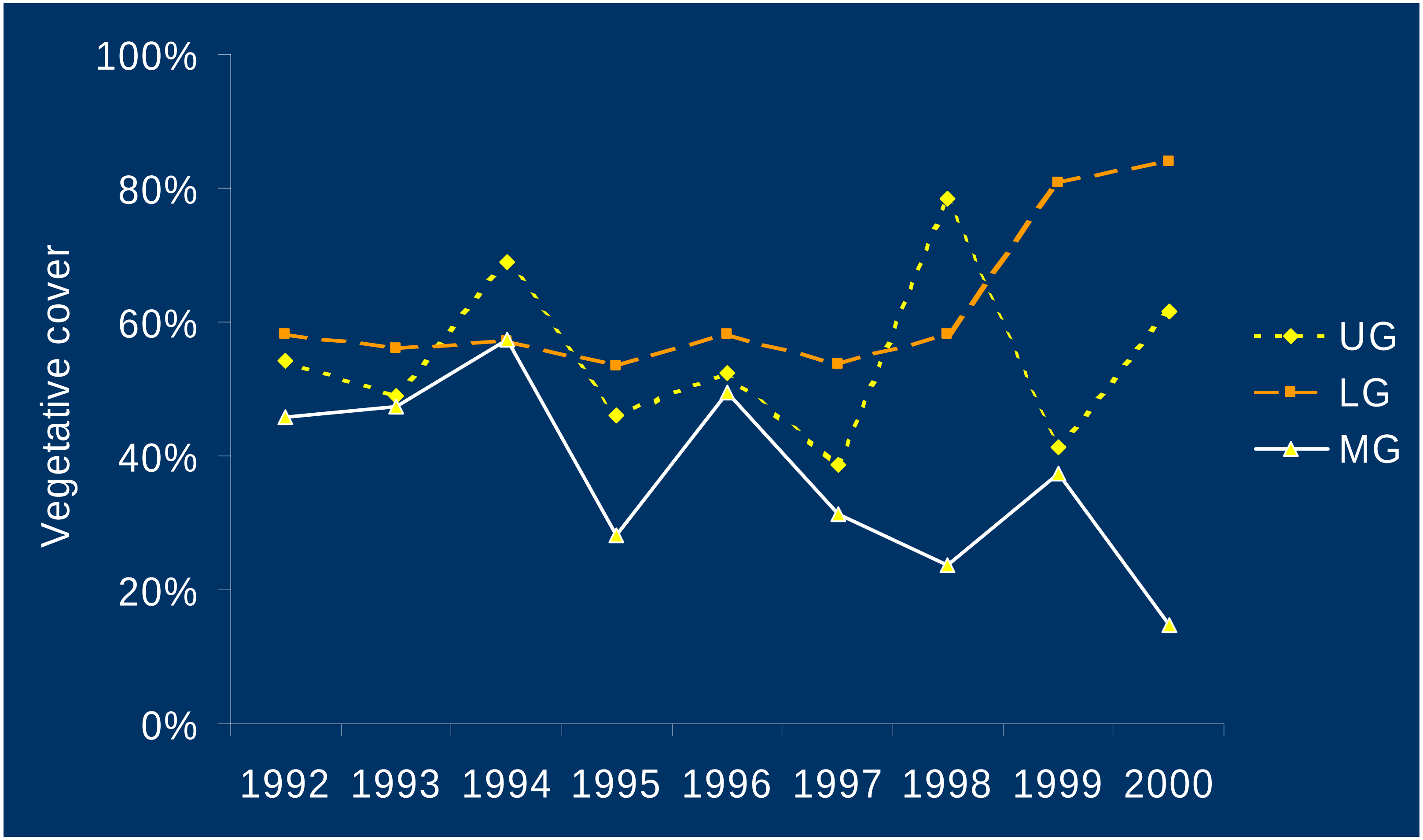


Insect Trap
Spring
10-m veg sampling transects
Permanent channel morphology transect
Channel



Springs
Nitrate mg/L
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
No Graze
Light Graze
Moderate Graze
Treatment
1993-94
2004-05


100%
80%
60%
40%
20%
0%
Vegetative cover
1992
1993
1994
1995
1996
1997
1998
1999
2000
UG
LG
MG



100%
80%
60%
40%
20%
0%
Vegetative cover
1992
1993
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2000
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LG
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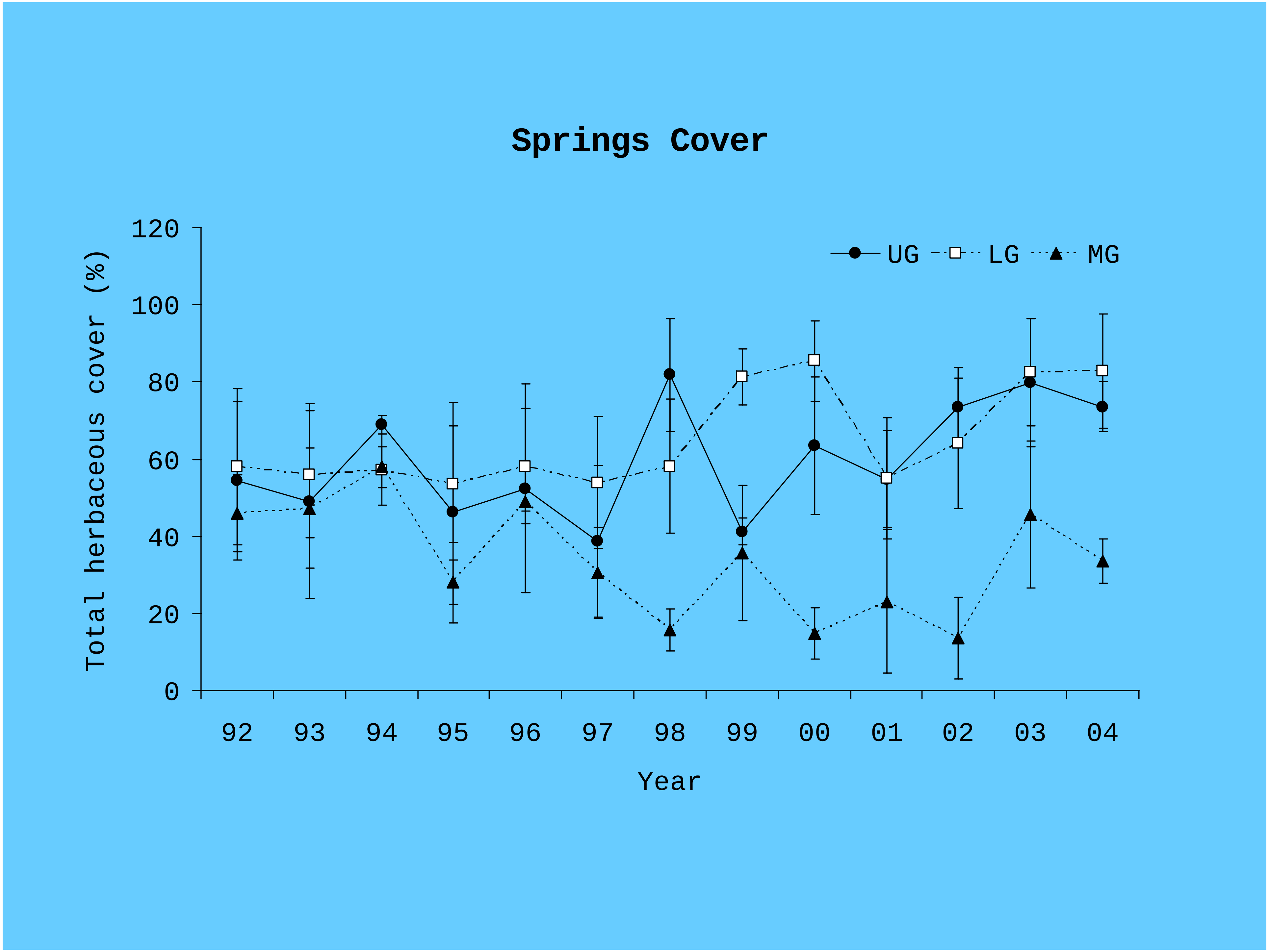
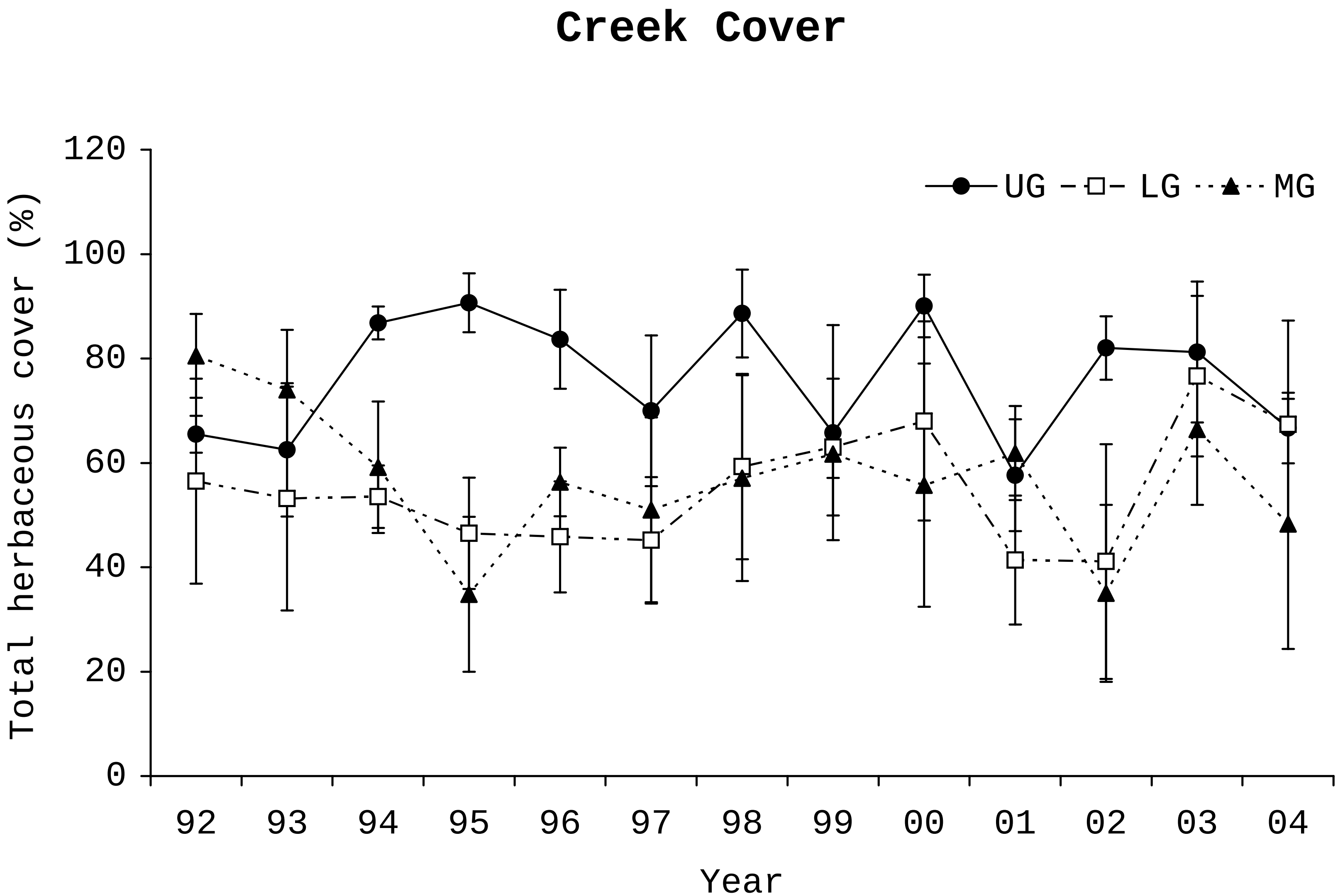


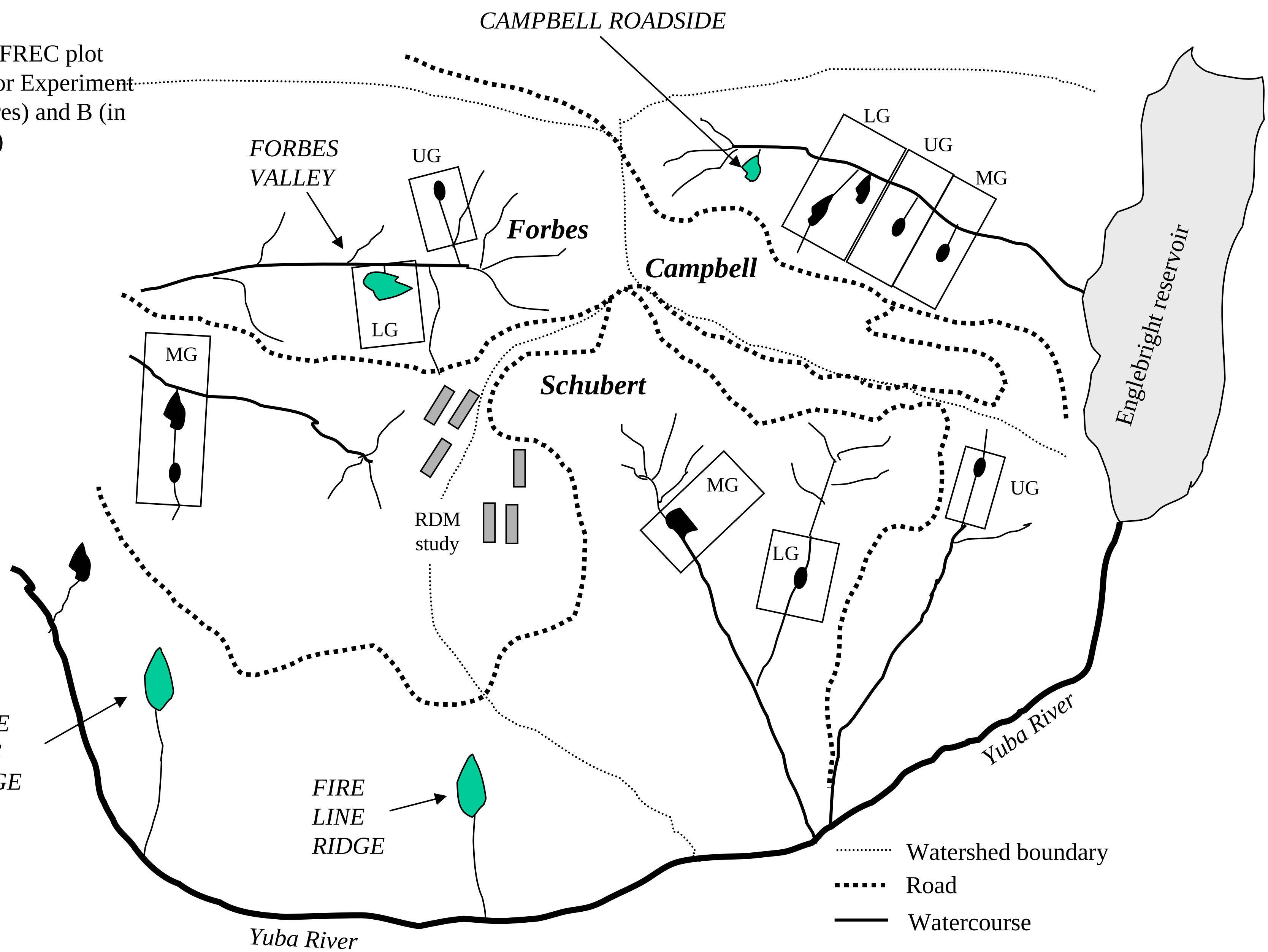
Springs Cover
Total herbaceous cover (%)
0
20
40
60
80
100
120
UG
LG
MG
92
93
94
95
96
97
98
99
00
01
02
03
04
Year



Creek Cover
UG
LG
MG
Total herbaceous cover (%)
0
20
40
60
80
100
120
92
93
94
95
96
97
98
99
00
01
02
03
04
Year

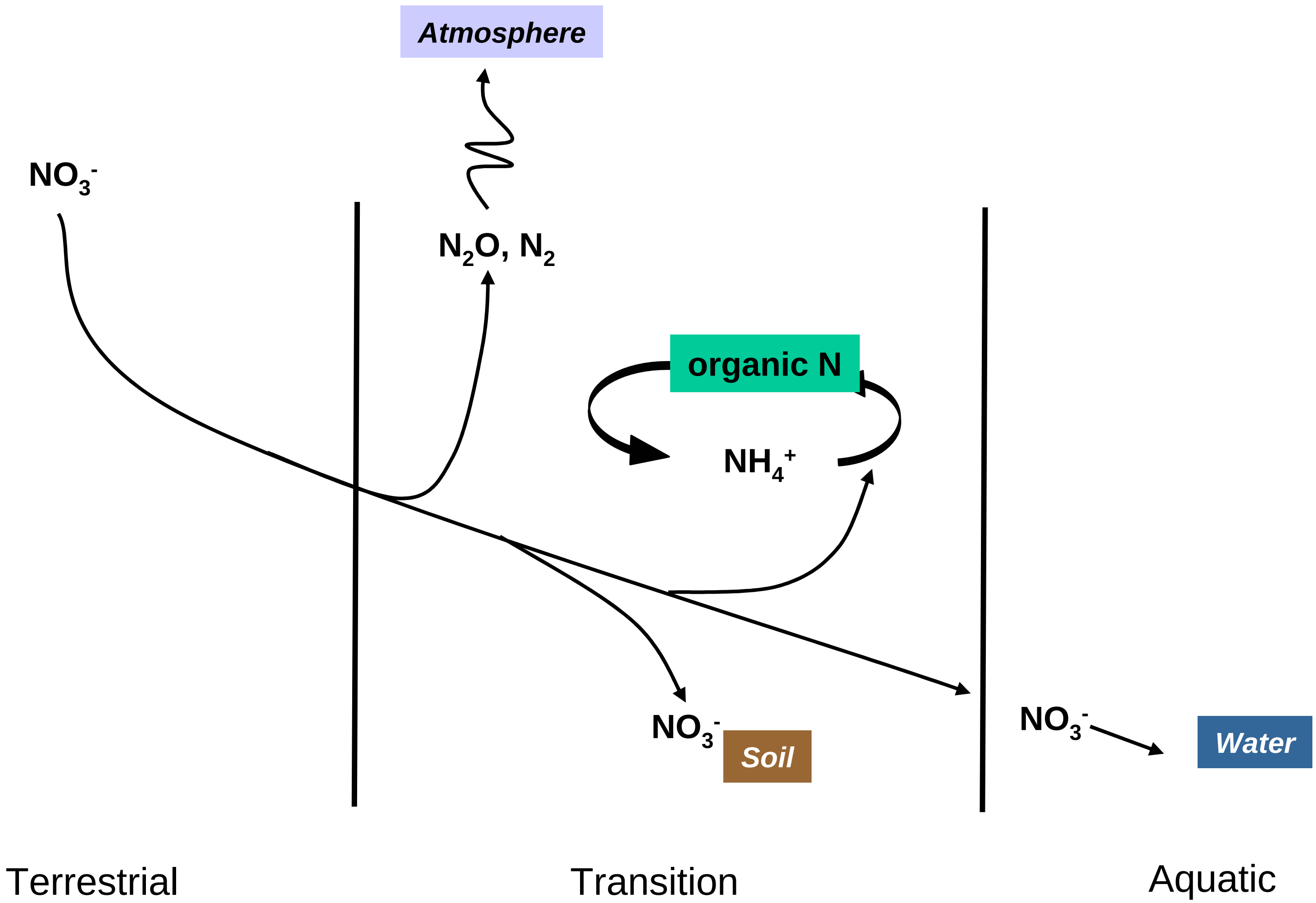
Moderately grazed springs resulted in decreased diversity
Of emergent aquatic insects

Figure 1. SFREC plot locations for Experiment A (in squares) and B (in blue-green)

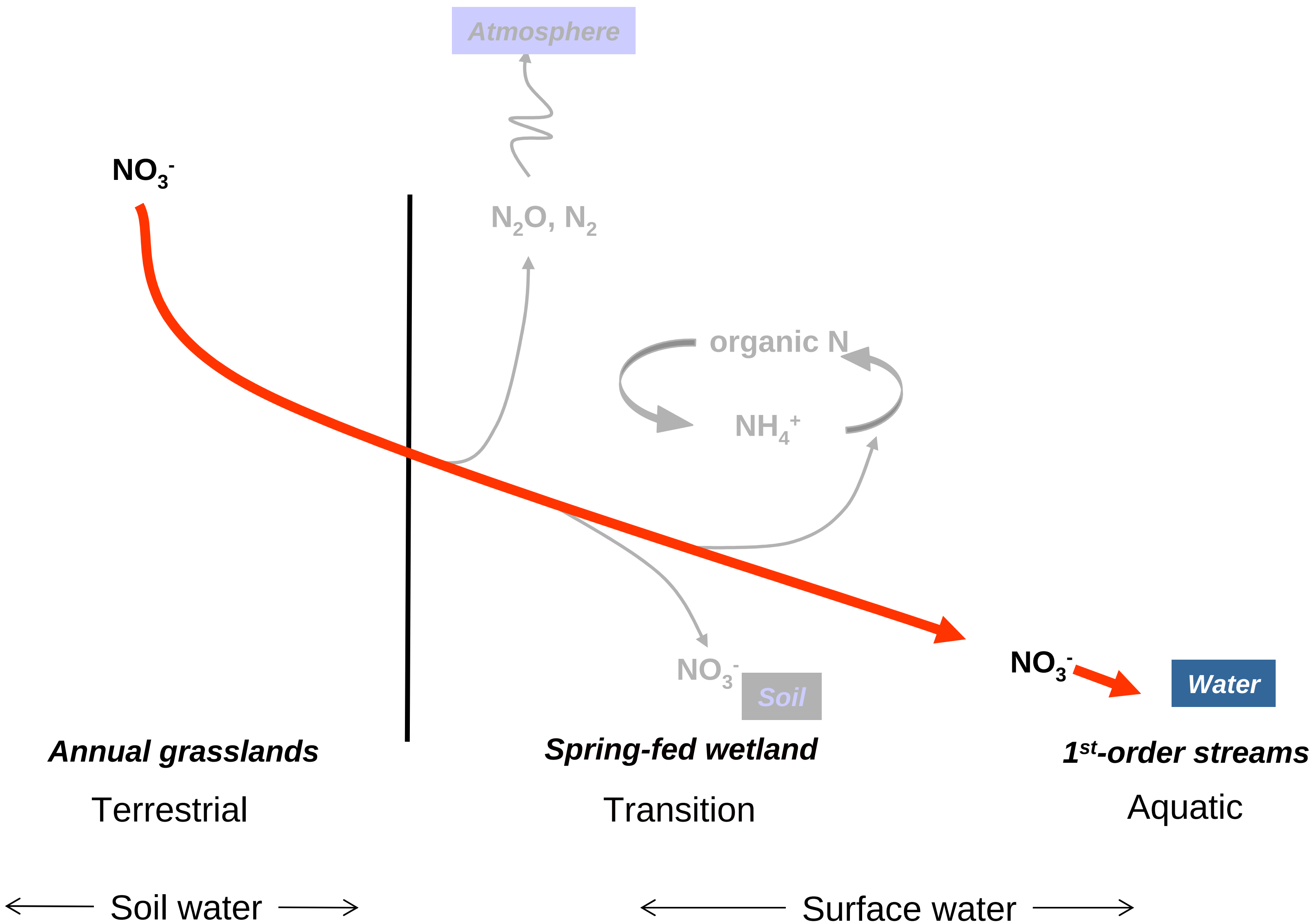


# Why N retention is important

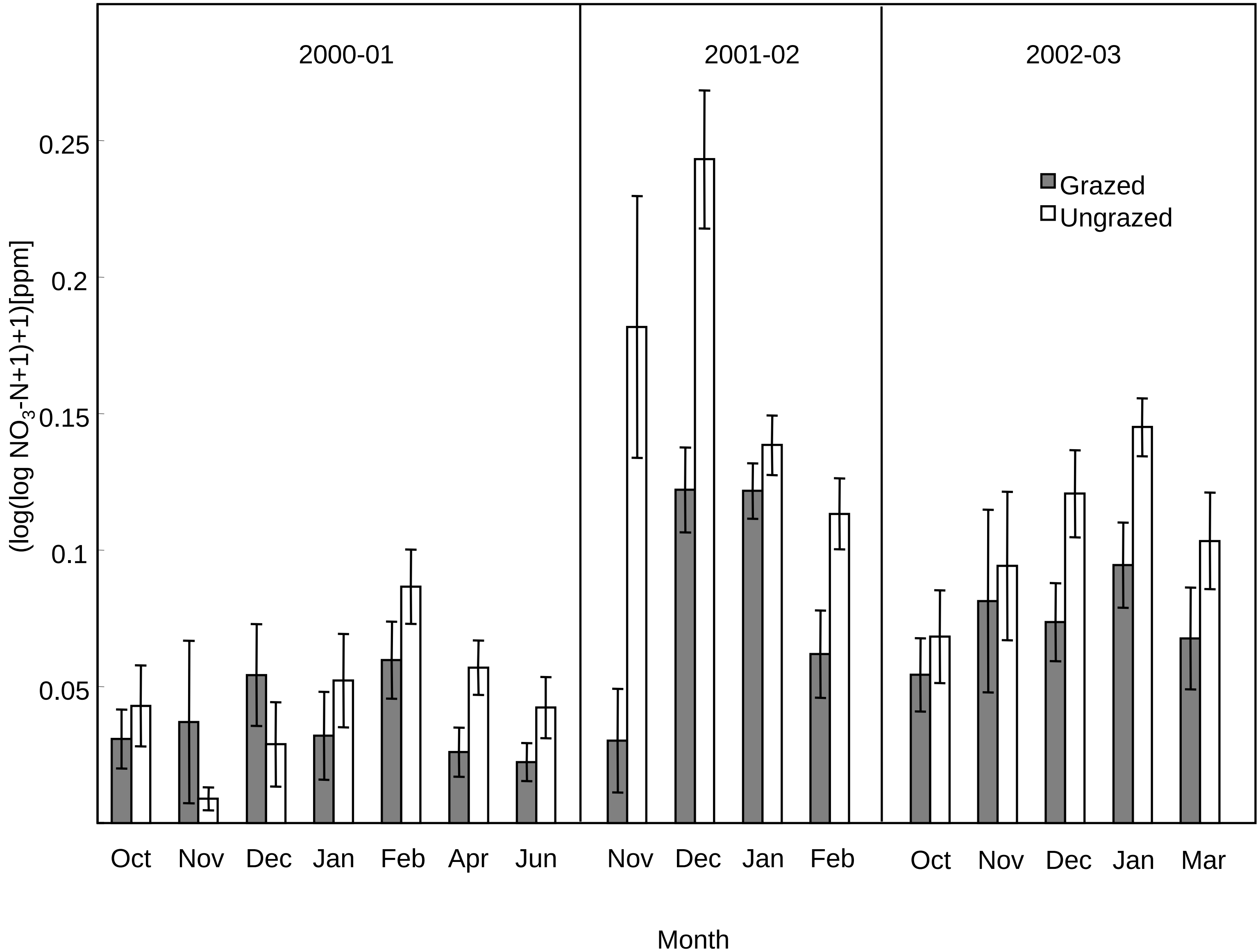
- N most limiting nutrient in temperate terrestrial ecosystems
- Highly mobile...doesn’t accumulate in soils
- 2 loss pathways...both more or less undesirable
  - Gaseous: $N_2O$ a greenhouse gas, but $N_2$ not
  - Aqueous: $NO_3^-$ pollutes ground and surface water



Atmosphere
$NO_3^-$
$N_2O$, $N_2$
organic N
$NH_4^+$
$NO_3^-$
Soil
$NO_3^-$
Water
Terrestrial
Transition
Aquatic


Atmosphere
$NO_3^-$
$N_2O$, $N_2$
organic N
$NH_4^+$
$NO_3^-$
Soil
$NO_3^-$
Water
Annual grasslands
Spring-fed wetland
1st-order streams
Terrestrial
Transition
Aquatic
Soil water
Surface water

# Nitrate concentrations in surface waters of spring-fed wetlands



*The Nitrate Story*

1) Annual grass dominated uplands are a $NO_3$ source to downslope ecosystems.

2) Surface water $NO_3$ concentrations appeared to respond to upland $NO_3$ pulse, but concentrations consistently low.

3) Spring-fed wetland sediments and waters maintained high $NO_3$ concentrations that increased with grazing removal.

4) Grazing removal significantly increased gaseous N loss.

# The methane story

- Trace gas emissions measured monthly from March to September 2002
- Temperature varied from 32$^oC$ (July) and 5$^oC$ in March
- Mean methane flux:
  - 9.29 +/- 4.37 mg $CH_4$-C $m^{-2}$ $hr^{-1}$
- Soil Water Content:
  - 39.66 +/- 2.29%

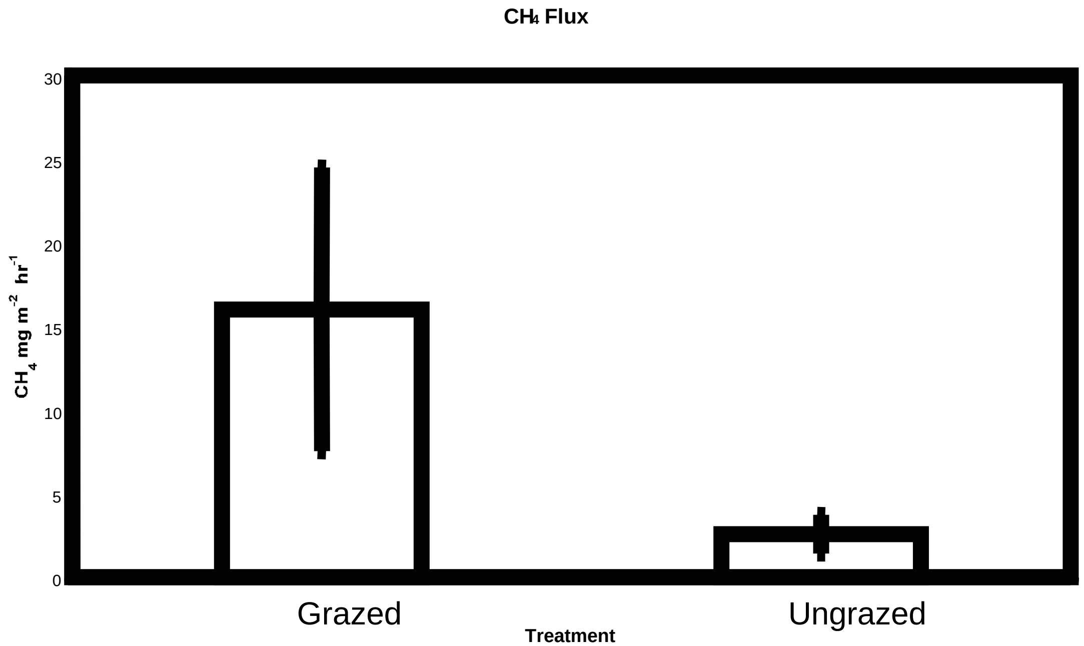



Figure 3. Comparison of Methane flux from grazed vs. ungrazed sites (mean and standard error).

Methane emissions are most closely correlated with temperature (warmer temperatures, more methane). Grazing removal results in decreased methane emissions.

*Summary*

*1)* These are resource-rich systems.

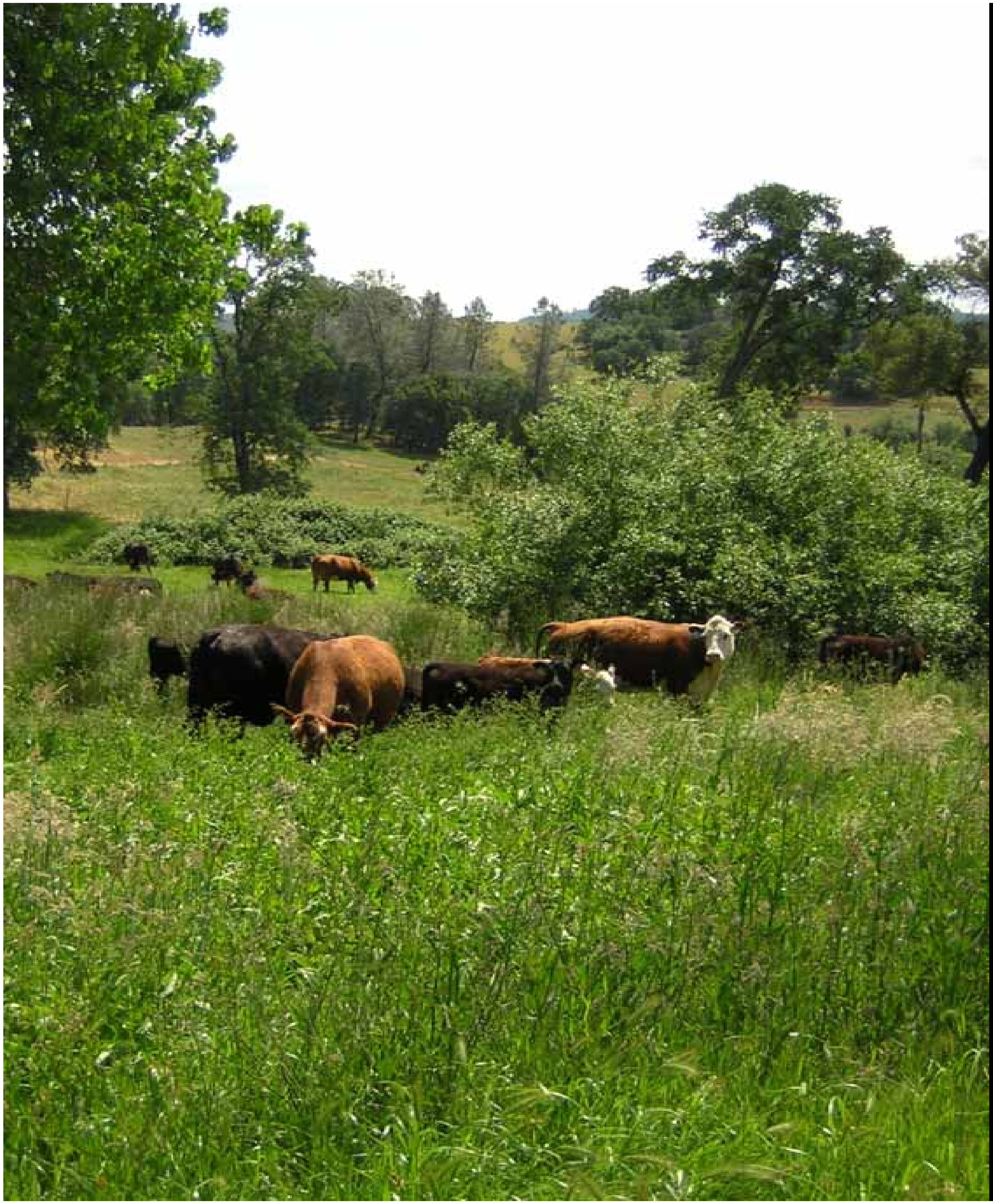
2) Vegetative cover decreases with moderate grazing over time, while lightly grazed springs maintain cover.

3) There was no change in the relative amounts of native and non-native species on any treatment.

4) Water quality and channel morphology did not respond to treatment.

# Summary

- Springs act as nutrient filters
- High herbaceous plant production is a key factor for maintaining these ecosystems
- Cattle grazing influences both productivity and composition
  - Remove livestock: increase nitrate levels
  - Remove livestock: decrease plant diversity
  - Remove livestock: decrease methane flux



Proper livestock grazing intensity can be used to achieve optimal mix of objectives.

In this case, light grazing as defined by RDM in the uplands.

Supported by:

Integrated Hardwood Range Management Program

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Private donor

James Bartolome, UCB
Randy Jackson, UW
Ken Tate, UC Davis
Mike Connor, UC SFREC
Dave Labadie, UC SFREC
Dustin Flavell, UC SFREC
Many, many grad students